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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : E21B 21/08, 7/128

A1

(11) International Publication Number: WO 93/06335

(43) International Publication Date: 1 April 1993 (01.04.93)

(21) International Application Number: PCT/GB92/01673

(22) International Filing Date: 11 September 1992 (11.09.92)

(30) Priority data:
9119563.6 13 September 1991 (13.09.91) GB

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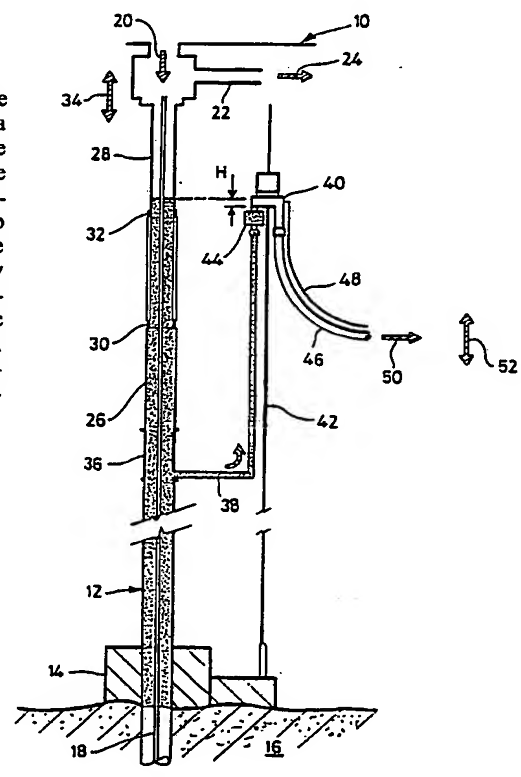
(81) Designated States: AT, AU, BB, BG, BR, CA, CH, CS, DE, DK, ES, FI, GB, HU, JP (Utility model), KP, KR, LK, LU, MG, MN, MW, NL, NO, PL, RO, RU, SD, SE, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: METHOD AND APPARATUS FOR SMOOTHING MUD RETURN FLUCTUATIONS CAUSED BY PLATFORM HEAVE

(57) Abstract

A drilling platform having a marine riser (12) extending down to the sea bed comprises a fluid outlet in the form of a feedpipe (38) connected to a manifold (49). The manifold is held fixed to the sea bed by a tensioned wire (42) and delivers the returning fluid mud via a flexible hose (46) to a shale shaker or other mud treatment facility. The mud may alternatively be indirectly discharged from the manifold via a collection tank (80) and pump (82). One of the parameters under constant surveillance is the flow rate of the returning drilling mud, since any sudden change in the return flow rate may indicate for example an influx of gas or fluid into the borehole. Unfortunately the variation in flow brought about by the rise and fall of the telescopic upper section of the marine riser can be such as to mask any variations in flow rate and thereby render instantaneous flow rate monitoring almost useless. The effect is a function of heave amplitude and rate, and becomes dominant for low pump rates.



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Title: METHOD AND APPARATUS FOR SMOOTHING MUD RETURN FLUCTUATIONS CAUSED BY PLATFORM HEAVE

Field of invention

This invention concerns floating drilling platforms or vessels, particularly oil well drilling platforms of the type which are connected to the sea bed by a tubular sleeve known as a marine riser, down through which the drill and drill string extends to the sea bed from the platform and in which fluid is forced under pressure around the cutting end of the drill in the bore in the sea bed and is recovered as a mud which is forced under pressure up the inside of the marine riser.

Background to the invention

In order to accommodate heave of the platform due to movement of the sea, the marine riser includes a telescopic upper section, and the returning fluid (mud) is taken from above the telescopic join through a flow line to the mud processing plant.

As the platform (or rig as it is commonly called) heaves up and down, the returning flow of drilling fluid fluctuates severely as the mud outlet of the marine riser alters to accommodate the heaving movement. When the rig heaves up the riser length is extended and the outflow is reduced by the need to fill the increased riser volume. Heaving down has the opposite effect.

One of the parameters under constant surveillance is the flow rate of the returning drilling mud, since any sudden change in the return flow rate may indicate for example an influx of gas or fluid into the borehole. Unfortunately the variation in flow brought about by the rise and fall of the telescopic upper section of the marine riser can be such as to mask any variations in flow rate and thereby render instantaneous flow rate monitoring almost useless. The effect is a function of heave amplitude and rate, and becomes dominant for low pump rates.

It has been proposed to employ a volumetric flow compensator to even out the flow, but direct measurement of flow rate is still preferred. It is an object of the present invention to provide an improved drilling platform return flow system in which the flow rate is smoothed out.

The invention is applicable to all drilling vessels of the type described but is of particular application to platforms during slimhole drilling in which the pump rate is relatively low.

Summary of the invention

According to one aspect of the invention there is provided a drilling platform comprising a marine riser having a fluid outlet held in a fixed position relative to the sea bed, so that the flow pattern of the returning mud is decoupled from the heave motion of the platform.

Preferably a flow measuring device is located at or near the fluid outlet.

According to a preferred feature of the invention, this

may be achieved by using a tensioned wire or cable stretched between the sea bed and the platform, sometimes called a guideline tensioner; or alternatively where the riser is provided with tensioners the latter may be used.

Returning mud may be led from the fixed position outlet directly to the shale shakers through a flexible hose and pipe, located and dimensioned so as not to generate back-pressure at the fluid flow measuring device as the platform heaves up and down.

According to a preferred feature of the invention, returning mud is tapped from the marine riser at a point just below the lower part of the telescopic section of the riser, and a feedpipe connects the tapping to an outlet manifold which is held stationary relative to the sea bed as by means of a tensioned wire.

Preferably the outlet manifold is kept approximately level with the top of the lower part of the telescopic section of the riser.

Preferably a flexible hose connects the outlet manifold to fixed pipework mounted on the platform to deliver the returning mud directly to the shale shakers. The flexible hose therefore comprises the flexible coupling between the platform and the sea bed.

During operations, as drilling fluid is pumped into the bore the level in the marine riser will rise until the differential head between the fluid in the riser and outlet manifold is sufficient to cause the returning mud to flow through the feed pipe, whereafter equilibrium is reached when the differential head corresponds to the

pressure drop for the given flow. A typical maximum flow rate is 1200 litres per minute, and using a 4" diameter feedpipe this requires a differential head of approximately 20".

Preferably the flexible hose, fed from the feedpipe, is of larger diameter than the feedpipe, so that the flexible hose drains the feedpipe without creating back-pressure.

A typical size for the flexible hose is 6" if the feedpipe is 4".

Preferably the flexible hose is vented by means of a separate pipeline leading from a first point beyond and above its outlet end to a second point in the outlet manifold linking the feedpipe to the flexible hose.

If an enclosed system is desired which includes a housing containing the mud treatment and drilling oil recovering apparatus, then the said first venting point may be in the said housing.

Preferably a non-return valve (or blocking valve) is employed to prevent fluid from getting into the air venting pipeline should the outlet manifold (between the feedpipe and the flexible hose) become full up.

By placing the flow meter in the feedpipe, below the outlet manifold, the flow meter will remain full at all times during operation.

A secondary measure of flow can if desired be obtained by measuring the height of fluid in the marine riser, as by means of a pressure, proximity or level sensor.

Preferably a short spool is installed in the riser between a fixed part thereof extending to the sea bed and the lower part of the telescoping section thereof, to provide an outlet connection to the feed pipe.

Conveniently valve means is provided to close off the spool outlet when the system is not in use or is to be disconnected.

The valve means may in addition or alternatively be remotely controllable.

The valve means may be self closing, should the control hoses fail.

Preferably the said outlet manifold is attached to the tensioned wire using a self-tightening wire clamping unit, which may to advantage be remotely operable. The clamping unit is preferably such that it can be used to position the manifold and to be unclamped when removing the manifold, as for example when using a tugger.

The remote control of the valve means and/or the wire clamping unit is preferably by means of compressed air.

The system can be flushed for cleaning and/or removing any build-up of cuttings by increasing the flow rate using the existing riser fill line to increase the flow through he outlet.

For direct discharge onto the shale shakers it is a requirement that there is sufficient headroom above the shale shakers on the platform. Where this is not the

case, indirect discharge may be employed via a collection tank and pump.

According to another preferred feature of the invention, the feedpipe may be self-supporting (or supported by a support member which is secured to and extends upwardly from the lower stationary section of the marine riser below the telescoping section). Such an arrangement eliminates the need for a tensioned wire support for the outlet manifold provided the self supporting feedpipe (or support member therefor) can carry the weight of the manifold, flowmeter and flexible pipe and can be designed for easy installation and removal.

The invention also lies in a semi-submersible oil drilling platform when fitted with an oil drilling mud treatment and recovery facility adapted to be linked to a marine riser having an outlet manifold for delivering drilling mud returned from the bore, wherein the outlet manifold is held stationary relative to the sea bed and is connected to the treatment and recovery facility by means of a flexible pipeline, to decouple the up and down movement of the facility from the manifold without generating back-pressure thereat.

The invention also lies in a method of treating and recovering oil drilling mud from a bore in the sea bed via a fixed marine riser the upper end of which can telescope to accommodate up and down movement of a drilling platform attached thereto, comprising the steps of tapping the returning mud from a point on the riser below the telescoping upper end thereof and feeding the returning mud via a feedpipe to a manifold which is held stationary relative to the sea bed and is located at a level below

the upper end of the lower fixed part of the two part telescoping section of the riser, so as to maintain a differential head between the level of the mud in the riser and that in the feedpipe sufficient to effect a substantially constant flow of mud therethrough, and feeding the mud from the manifold to mud treatment means via a pipeline at least a part of which is flexible and extends between the fixed manifold and the platform to decouple the up and down movement of the latter from the manifold without creating back-pressure thereat.

The invention also lies in a marine riser for use with a drilling platform, down through which a drill carried by the rig can pass for drilling the sea bed below and up through which drilling mud is forced under pressure for recovery and treatment (particularly to remove rock cuttings from the mud well bore), wherein the riser includes an upper two-part telescoping section to accommodate up and down movement of the platform due to the movement of the sea, characterised in that a tapping is provided in the riser below the lower of the two parts making up the telescoping section, and a feedpipe is provided which extends upwardly to a fixed point approximately at the level of the upper end of the lower of the two telescoping parts.

The precise position of the said fixed point is preferably adjustable and typically is determined by clamping to a tensioned wire, the lower end of which is anchored to the sea bed.

The feedpipe may be self-supporting and/or may be attached via a steady to the marine riser and/or to a tensioned wire stretched from the sea bed to, for example, the

platform.

Description

The invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is a schematic illustration of a marine riser and return fluid discharge system incorporating the invention for use with a semi-submersible drilling rig (not shown);

Figure 2 is a view similar to Figure 1 but showing in greater detail an actual system as may be employed on a rig;

Figures 3a - 3c illustrate how a constant head is maintained during displacement of a rig due to heave.

Figure 4 is a modification of the embodiment of Figure 1;

Figure 5 is a modification of Figure 4; and

Figures 6 and 7 are further embodiments of the invention.

In Figure 1 the floor of a rig is denoted by reference numeral 10 and a marine riser extending from the floor 10 to the sea bed is denoted generally by reference numeral 12. The riser passes through a blow-out preventer housing 14 located on the sea bed, and extends into the sea bed 16 and into the bore which is being drilled by a drilling head (not shown) at the lower end of a drill shaft 18. The latter extends co-axially down the centre of the marine riser 12.

Drilling fluid is pumped down the hollow interior of the

drill shaft 18 in the direction of arrow 20 from a reservoir and pump located on the rig (not shown).

Hitherto drilling mud (a mixture of the original drilling fluid, solids, water, sand and the like) has been returned to the drilling platform through the marine riser and has been expelled from the upper end of the marine riser along an outlet tube 22 in the direction of arrow 24.

Since the drilling platform or rig is a semi-submersible vessel which floats, the height of the rig above the sea bed 16 will vary due to movement of the sea, wave motion, tide etc. To accommodate this movement the marine riser 12 includes a telescoping section at its upper end. Thus the upper end of the fixed section of the marine riser is formed by an outer sleeve 26 and the movable part of the marine riser comprises an inner sleeve 28 which is telescopically slidable within the stationary sleeve 26 and is sealed at 30 and 32 to prevent ingress of sea water and egress of mud etc.

Essentially the motion of the platform is up and down, as denoted by arrow heads 34. Consequently, provided the telescoping sleeves 26 and 28 can accommodate the maximum amplitude of heave, the marine riser will remain attached to the platform at all times.

By monitoring the return flow of mud from the sea bed, it is possible to indicate quickly whether there has been a sudden change in drilling conditions such as an influx of gas or fluid into the bore hole. Unfortunately due to heave, the return flow through the outlet pipe 22 can fluctuate quite dramatically, and a 12 foot variation of riser height is not unusual due to rig heave.

Consequently various techniques have been tried in an attempt to smooth out the flow of the drilling mud so that sudden changes in flow rate can be detected and are not masked by the changes in flow rate due to heave.

None of the tried techniques are particularly satisfactory, and all are expensive and require additional hardware and associated maintenance. The present invention provides a very simple alternative to such arrangements as will be described.

A spool 36 having a branch outlet or feedpipe 38 is located between the stationary telescoping part 26 and the fixed lower part of the marine riser. The feedpipe 38 extends not only laterally but also upwardly to a manifold 40 which is situated at a point approximately equal to the upper end of the stationary telescoping section 26.

The height of the manifold 40 is determined by clamping it to a tensioned wire rope generally designated 42 which extends from the blow-out preventer housing 14 on the sea bed to the semi-submersible rig. A constant tension is maintained in the wire rope 42 such as to maintain at least that section of the rope between the manifold 40 and the sea bed straight and taught. The manifold 40 is thus maintained at a constant height above the sea bed irrespective of the level of the sea, which of course affects the height of the semi-submersible rig above the sea bed.

The vertical position of the manifold 40 is initially adjusted such that, irrespective of the heave position of the rig, the mud always flows through the feedpipe 38, in preference to flowing up the inner sleeve 28 of the riser

12 and along the outlet tube 22. The differential head, indicated at H, between the level in the riser 12 and the level in the branch 38 constitutes the pressure required to cause flow in the branch outlet 38, and is a function of the pressure loss in the outlet 38 which in turn is a function of the flow properties of the mud and of its flow rate.

A flow meter 44 is located at the upper end of the feedpipe 38 where the latter enters the manifold 40, and by locating this below the level to which the mud will rise in that branch, so the flow meter will always be full.

Increasing the flow will increase the differential head H and increase the rate of flow of mud through the manifold 40.

In the preferred embodiment a flexible hose or pipe 46 is connected to the manifold 40 for discharging mud, as will be described. Alternatively the manifold may form part of a collection tank from which mud can be pumped.

The important aspect is that flow through the meter 44 will be substantially constant provided the differential head, denoted by H in Figure 1, is maintained substantially constant during the drilling operation. The precise flow will be determined by the actual value of the differential head and the flow characteristics of the mud in the branch 38. In a typical installation, a 20" differential head is equivalent to approximately 1200 litres per minute flow of mud through the branch 38 and the manifold 40.

In the preferred arrangement shown in the drawings, the manifold 40 merely serves to convey returning mud to the larger diameter flexible pipe 46 from which it can be discharged to a treatment device such as a vibratory screening apparatus or shale shaker to begin the process of separating solids from the fluids, as a first step to recovering the drilling mud originally pumped into the drill at 20.

By having the diameter of the pipe 46 larger than the branch pipe 38, so the hose 46 will drain the outlet manifold without creating back-pressure; and as a further aid, air venting may be provided between the discharge end of the pipe 46 and the manifold, via an airline 48.

An important important additional advantage of the present invention is that the returning mud is fed to the treatment device at a constant flow rate, instead of the intermittent flow rate which occurs in conventional rigs during heave. Thus, for example, the shale shakers can be adjusted for higher efficiency operation at such constant flow.

The tensioned wire 42 is a convenient device for maintaining the manifold 40 at a fixed position; but it will be appreciated that if the branch tube 38 is made sufficiently rigid and self-supporting so as to carry the weight of the flow compensator assembly via the riser 12 (which is itself rigid and fixed to the seabed), the wire 42 can then be dispensed with.

It should be noted that if no provision is made for adjusting the height of the manifold 40, the only way in which the differential head H will be altered is by

varying the pumping rate at 20.

The mud treatment apparatus (not shown) to which the mud is directed in the direction of arrow 50 is of course mounted on the semi-submersible rig and is therefore subject to heave as denoted by the arrow heads 52. However the heave movement of the treatment apparatus is effectively decoupled from the branch tube 38 and the flow meter 44 by means of the flexible tube 46 and the air venting, so as to eliminate back-pressure.

In the embodiment shown in Figure 2, those items which are common to Figures 1 and 2 are indicated by the same reference numerals. In this case a flexible tube is shown linking the branch outlet to the manifold 40 and flow meter 44 and this is denoted by reference numeral 54. The flexible tube is connected by a gland 56 to a short rigid branch pipe 58 containing a shut-off valve 60 which is preferably remotely controllable.

The discharge end of the flexible tube 46 communicates with a still larger diameter feed tube 62 for supplying the mud to the treatment apparatus such as a shale shaker (not shown). By choosing pipes of increasing diameter, and providing an air vent along line 48 between the end space at 64 in tube 62 and the manifold 40, so a flow pattern such as shown in Figure 2 can be established in which there is always a decoupling air space in the upper left hand section of the U-tube formed by the flexible pipe 46 in the volume denoted by reference numeral 66. Mud flowing through the flow meter 44 passes through the manifold 40 and runs down into the U-tube 46 and establishes a differential head K between the liquid level in the left hand branch and that in the right hand branch

of the hanging flexible tube 46. As soon as this head is large enough to cause liquid to leave via the larger diameter tube 62, it does so thereby maintaining substantially constant the level of the mud within the two branches of the tube 46. Obviously with increasing flow rates the differential height K must increase, but by ensuring that the flow rate never increases the differential height K such that the volume 66 is reduced to zero, there is always an air space between the fluid in the U-tube 46 and the manifold 40 and any increase in back-pressure due to increasing height of fluid in the left hand branch of the U-tube 46 is immediately compensated by the air bleed through the pipe 48.

The arrangement as shown in Figure 2 does not immediately lend itself to a totally sealed system in which the pipe 62 discharges into a sealed housing in which the treatment apparatus is located. In that event, the air bleed tube 48 is more preferably fed direct to the sealed housing (not shown) rather than to the tube 62, so that even if pipe 62 were to become filled with flowing fluid, the volume 66 is still vented to a relatively large reservoir of air which can act as a cushion and absorb and thereby iron out local increases in pressure within the volume 66.

In a preferred system, the pipe 46 is a 30 foot length of pipe or hose having an internal diameter of 4", the pipe 46 is some 20 feet long of flexible material and has an internal diameter of 6" and the pipe 62 is a metal or other rigid material pipe of 9" internal diameter.

Where the pipe 54 is self-supporting such as might be the case in Figure 1, and the support provided by a tensioned

wire such as 42 is not required, a steady may be provided between the manifold and the upper end of the stationary part 26 of the telescoping section of the marine riser.

In each of the embodiments shown, the movement of the inner sleeve 28 within the outer sleeve 26 will in fact generate a small heave related volume variation. This can largely be overcome by inverting the telescoping part so that the stationary member of the two telescoping sleeves has the smaller diameter.

Figures 3a-3c show the different positions of the flexible hose 46 during a heaving motion. Thus Figure 3a illustrates the situation in which the rig is at the upper end of the heave amplitude, Figure 3b at a mid position and Figure 3c at the lower end of the travel occasioned by the heave.

In each of the views, reference numeral 70 identifies the drill floor of the rig and reference numeral 72 the main deck of the rig. It is assumed that the treatment apparatus such as shale shakers is located on the main deck of the rig. Other parts identified in Figures 3a-3c are identified by the same reference numerals as are employed in Figures 1 and 2.

Clearly there are occasions when due to blockage or excessive heave it is conceivable that the level of the mud in the marine riser 12 may exceed that shown in the drawings. To accommodate such situations, the original flow line 22 is retained at the upper end of the movable telescoping riser member 28 and a pipeline (not shown) communicates between the flow pipe 22 and the treatment apparatus so that any such excess mud is returned

nevertheless to the treatment apparatus. Although not shown, warning means may be provided to indicate that such an excess has occurred since this could indicate a blockage in the branch line 54 or flow meter 44, manifold 40 or any of the other pipelines fed therefrom, or that there has been a sudden increase in pressure in the bore hole, and in any such situation a warning is required. Such a warning may for example be a pressure or level sensor within the telescoping member 28 just below the outlet 22 or may be a flow sensing device located in outlet 22 or in any pipe communicating therewith.

Figure 4 shows a modification of the embodiment of Figure 1 to take account of the situation in which the mud treatment apparatus is at a higher level than the manifold 40. Here the mud is received into an intermediate tank 80 from where it is pumped by a pump 82 through a pipe 84. The mud is then fed in the direction of arrow 50 to the treatment apparatus (not shown) mounted at a height above the main deck 72 of the rig.

A level sensor and/or control system 86 is provided at the tank 80 to control the output of the pump 82, to avoid the tank either overflowing or being pumped dry. Alternatively, the pump 82 may be a self-priming pump whose output is equal to or greater than the rate of circulation of the mud. In this case the complications of the sensor and control system 86 can be dispensed with, as the pump will then be self-regulating.

Figure 5 shows a further modification of the arrangement of Figure 4. In this case the pump 82 and tank 80 are mounted below the manifold 40 as an integral part thereof. Other reference numerals are as in Figure 4.

Instead of being mounted integrally below the manifold 40, as in Figure 5, the pump and tank could alternatively be mounted directly from the riser 12. This is shown in the embodiments of Figures 6 and 7.

Referring first to Figure 6, the marine riser 12 again has a telescopic joint section with an inner slip joint sleeve 28 slidable in an outer sleeve 26, as in Figure 1. However in this case an outer sheath 27 is additionally mounted around the sleeve 26 to provide an annulus 29 along which mud can flow. An outlet is formed at the top of the sheath 27 which is connected to the flow meter 44. From the meter the mud flows by gravity past a vacuum breaker 90 over a weir 92 and along the flexible pipe 46 to the shale shaker (not shown) on the deck 72 of the rig.

The arrangement in Figure 7 is similar to Figure 6 except that the mud is collected in a tank 80 below the weir 92. From the tank the mud is then fed by a pump 82, instead of by gravity, to the shale shaker (not shown).

The arrangements of Figures 7 and 8 have the advantage of simplicity, and without requiring any wires or cables to the sea bed.

The present invention is of particular application to slimhole drilling where there is sufficient height between the outlet and the mud treatment apparatus (such as shale shakers), as is found on the Sedco 707 Rig in the North Sea.

CLAIMS

1. A drilling platform comprising a marine riser having a fluid outlet, fixing means for holding the fluid outlet at a fixed position relative to the sea bed, so that the flow pattern of the returning fluid mud is decoupled from the heave motion of the platform.

2. A platform according to claim 1, further comprising a flow measuring device located at or near the fluid outlet.

3. A platform according to claim 1 or claim 2 in which the fixing means comprises a tensioned wire or cable stretched between the sea bed and the platform.

4. A platform according to claim 1 or claim 2 in which the riser comprises an upper telescopic section and the returning mud is tapped from the marine riser at a point just below the telescopic section, and a feedpipe constituting the fluid outlet connects the tapping to an outlet manifold which is held stationary relative to the sea bed by means of a tensioned wire.

5. A platform according to claim 4 in which the outlet manifold is kept approximately level with the top of the lower part of the telescopic section of the riser.

6. A platform according to claim 4 or claim 5 in which a flexible hose connects the outlet manifold to fixed pipework mounted on the platform to deliver the returning

mud directly to a mud processing apparatus.

7. A platform according to claim 6 in which the flexible hose is of larger diameter than the feedpipe, so that the flexible hose drains the manifold without creating back-pressure.

8. A platform according to claim 6 or claim 7 in which the flexible hose is vented by means of a separate pipeline leading from a first point beyond and above its outlet end to a second point in the outlet manifold linking the feedpipe to the flexible hose.

9. A platform according to claim 8 in which a non-return valve is employed to prevent fluid from reaching the air venting pipeline if the outlet manifold become full.

10. A platform according to any one preceding claim in which a secondary measure of flow is obtained by measuring the height of fluid in the marine riser, by means of a pressure, proximity or level sensor.

11. A platform according to any one of claims 4 to 10 in which a spool is installed in the riser between a fixed part thereof extending to the sea bed and the lower part of the telescoping section thereof, to provide an outlet connection to the feedpipe.

12. A platform according to claim 11 in which valve means is provided to close off the spool outlet when the system is not in use or is to be disconnected.

13. A platform according to claim 12 in which the valve means is self-closing.

14. A platform according any one of claims 4 to 13 in which the outlet manifold is attached to the tensioned wire by a self-tightening wire clamping unit.

15. A platform according to any one of claims 12 to 14 in which the valve means and/or the wire clamping unit are remotely controllable, preferably by means of compressed air.

16. A platform according to claim 1 or claim 2 in which the fluid outlet comprises a feedpipe which is self-supporting, or is supported by a support member which is secured to and extends upwardly from a lower stationary section of the marine riser.

17. A platform according to claim 1 or claim 2 in which the marine riser comprises a telescoping section and having an outer sheath to the upper end of which is connected the fluid outlet.

18. A platform according to any one preceding claim in which the returning mud is indirectly discharged via a collection tank and pump.

19. A drilling platform comprising a drilling mud treatment facility linked to a marine riser having an outlet manifold for delivering drilling mud returned from a bore in the sea bed, the outlet manifold being held stationary relative to the sea bed and being connected to the treatment facility by means of a flexible pipeline, to decouple the up and down movement of the facility from the manifold without generating back-pressure thereat.

20. A method of treating and recovering drilling mud from a bore in the sea bed via a fixed marine riser whose upper end can telescope to accommodate up and down movement of a platform attached thereto, comprising the steps of tapping the returning mud from a point on the riser below the telescoping upper end thereof and feeding the returning mud via a feedpipe to a manifold which is held stationary relative to the sea bed and is located at a level below the upper end of the lower fixed part of a two-part telescoping section of the riser, so as to maintain a differential head between the level of the mud in the riser and that in the feedpipe sufficient to effect a substantially constant flow of mud therethrough, and feeding the mud from the manifold to a mud treatment means via a pipeline at least a part of which is flexible and extends between the fixed manifold and the platform, thereby to decouple the up and down movement of the latter from the manifold without creating back-pressure thereat.

21. A marine riser for use with a drilling rig down through which a drill carried by the rig can pass for drilling the sea bed below, and up through which drilling mud is forced under pressure for recovery and treatment, wherein the riser includes an upper two-part telescoping section to accommodate heave, characterised in that a tapping is provided in the riser below the lower of the two parts making up the telescoping section, and a feedpipe is provided which extends upwardly to a fixed point approximately at the level of the upper end of the lower of the two telescoping parts.

22. A marine riser according according to claim 21 in which the position of said fixed point is determined by clamping to a tensioned wire, the lower end of which is

anchored to the sea bed.

23. A marine riser according to claim 21 or claim 22 in which the feedpipe is self-supporting and/or is attached via a steady to the marine riser and/or to a tensioned wire stretched from the sea bed to the rig.

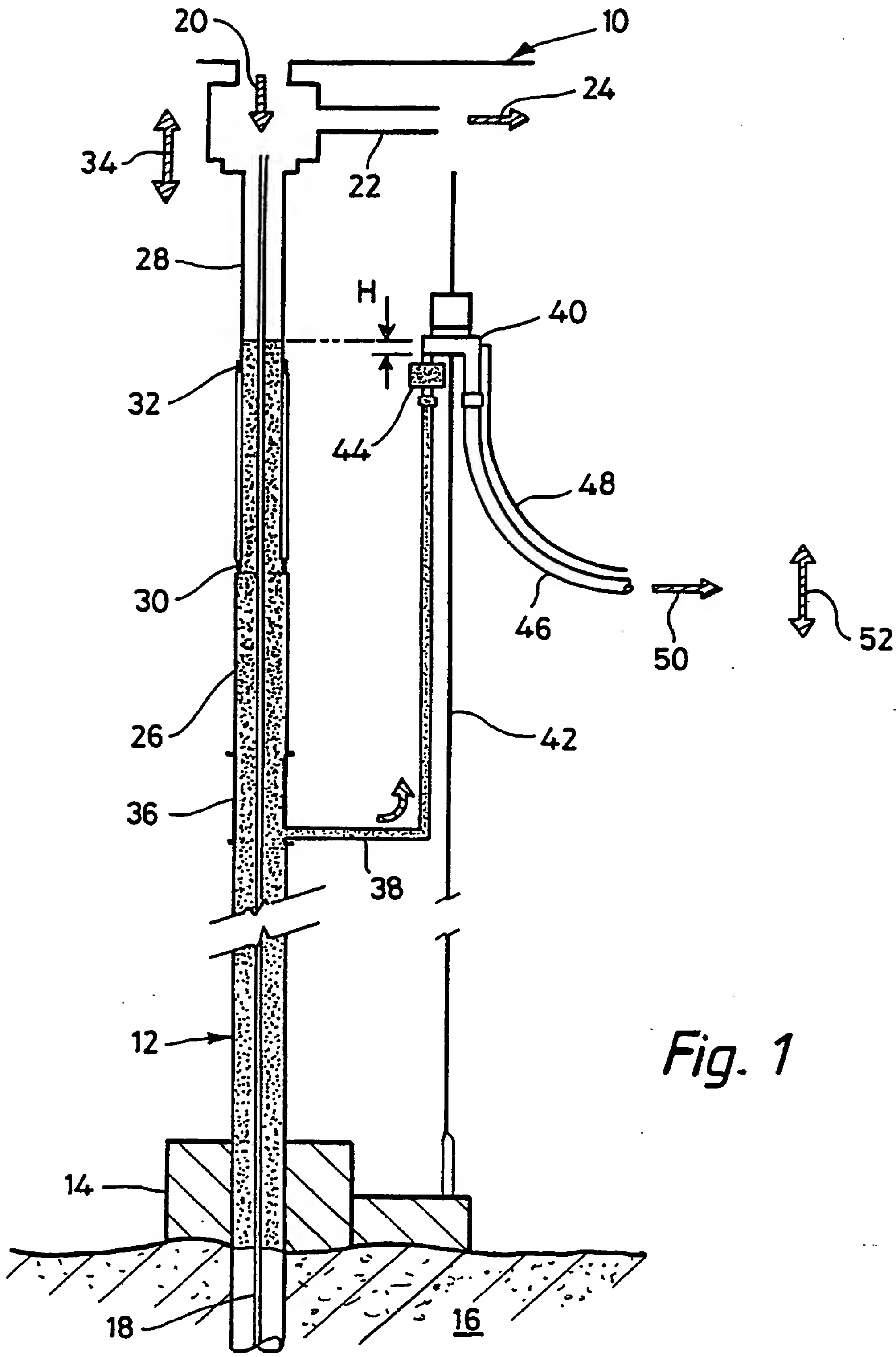

Fig. 1

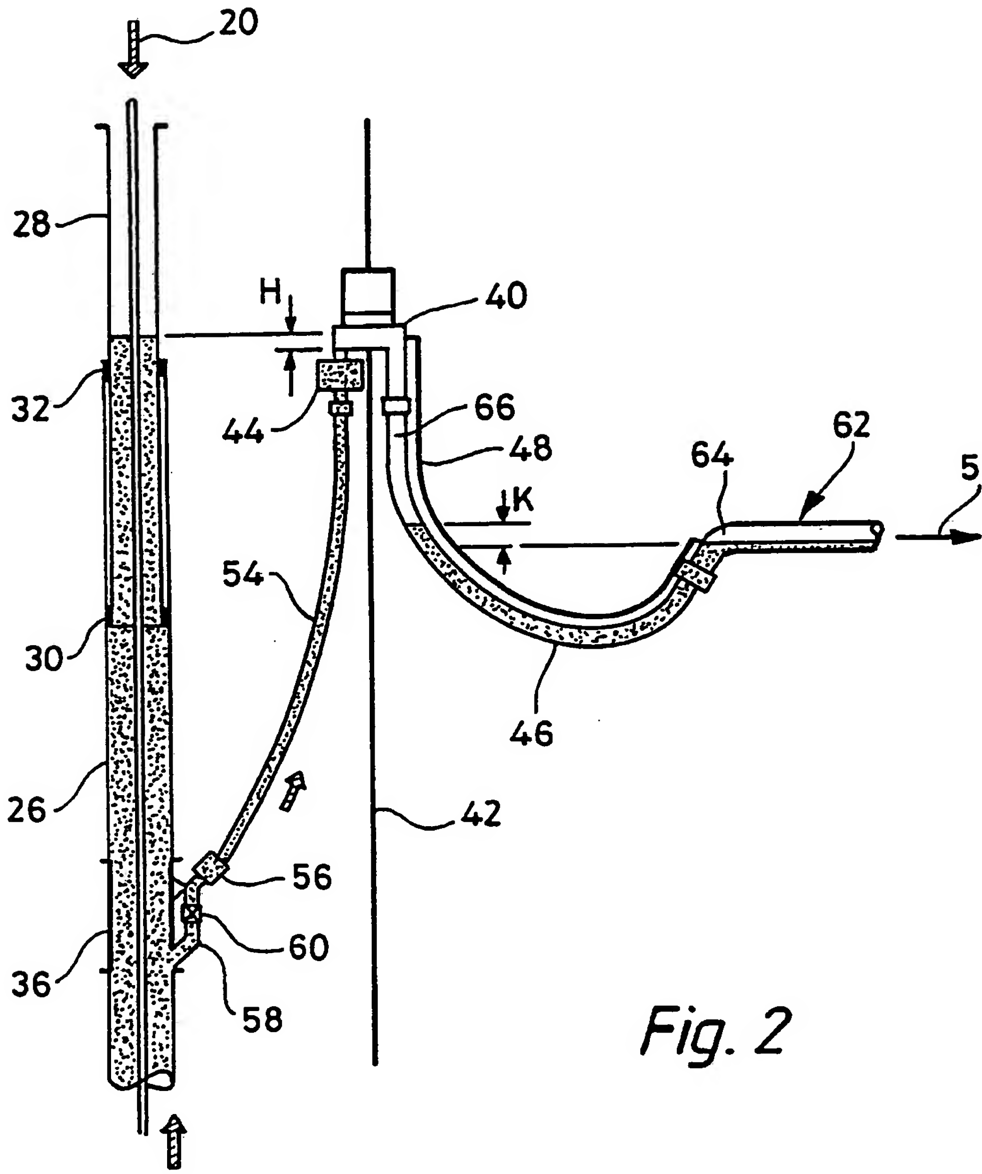

Fig. 2

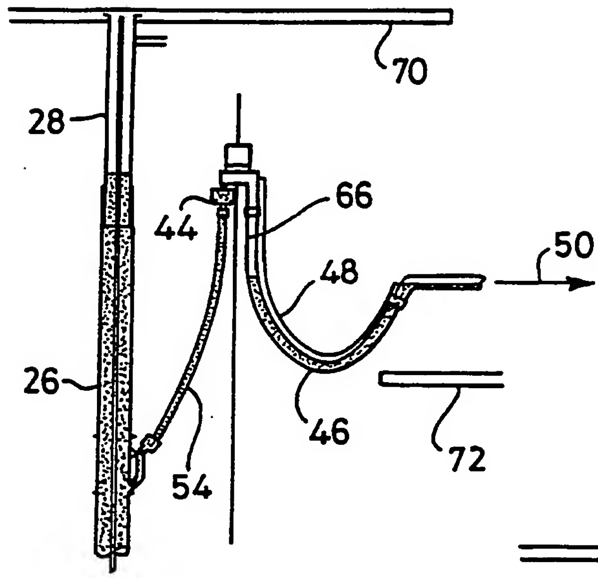

Fig. 3a

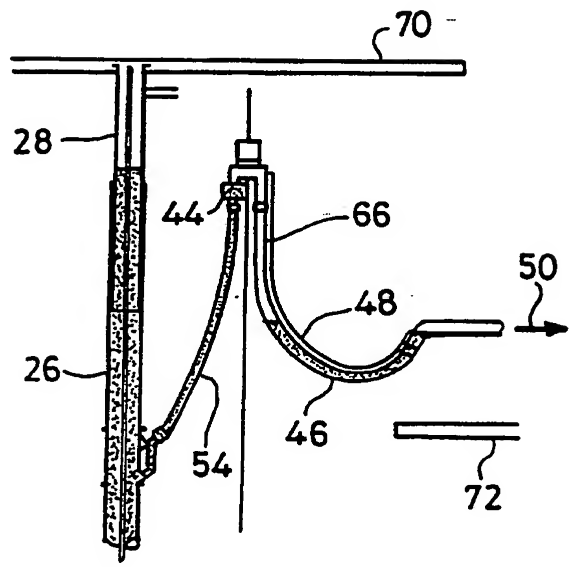

Fig. 3b

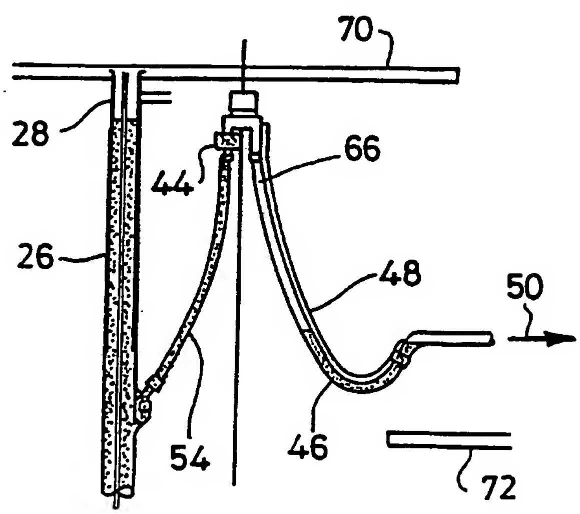

Fig. 3c

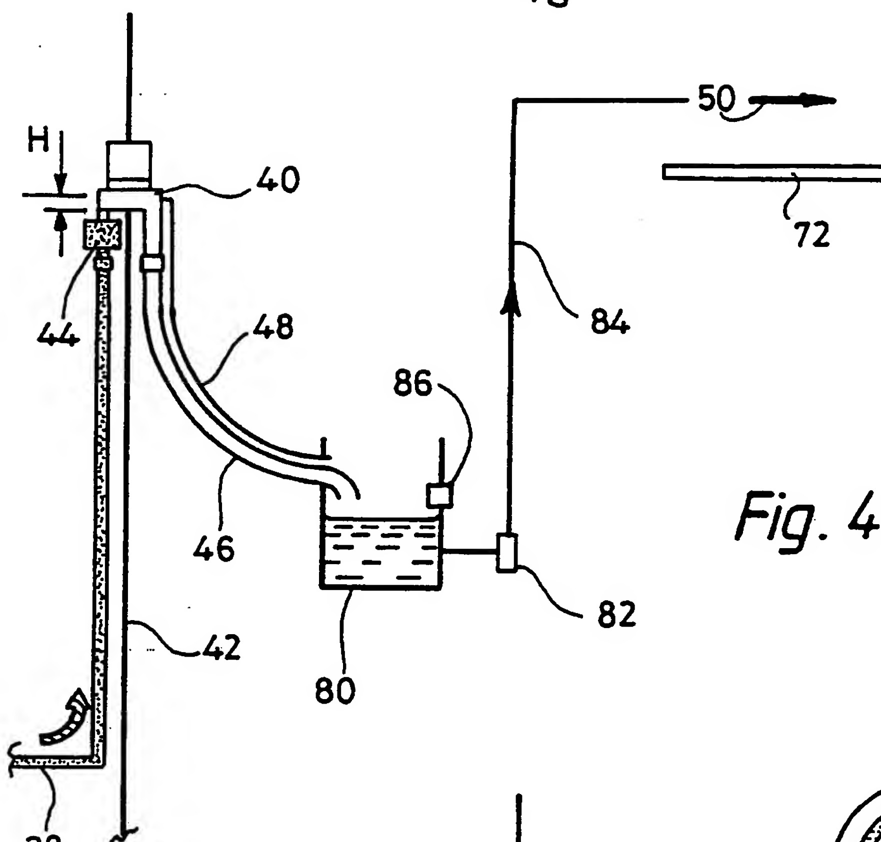

Fig. 4

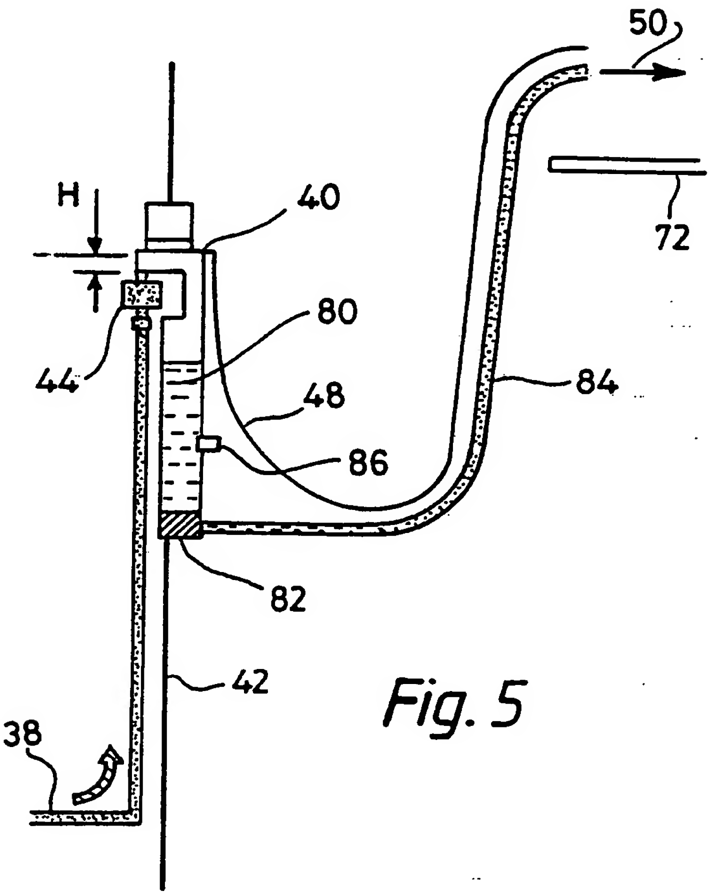

Fig. 5

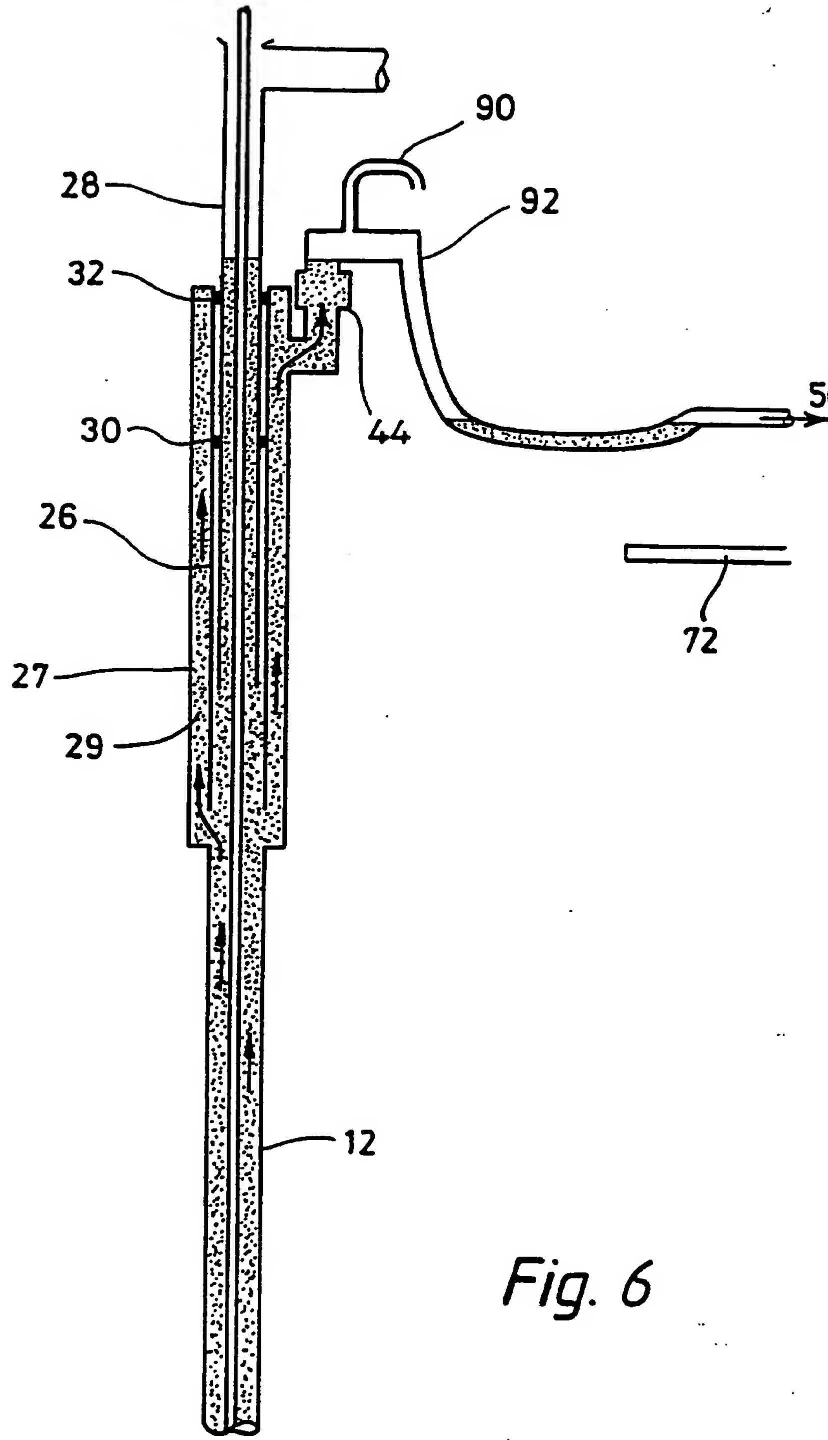

Fig. 6

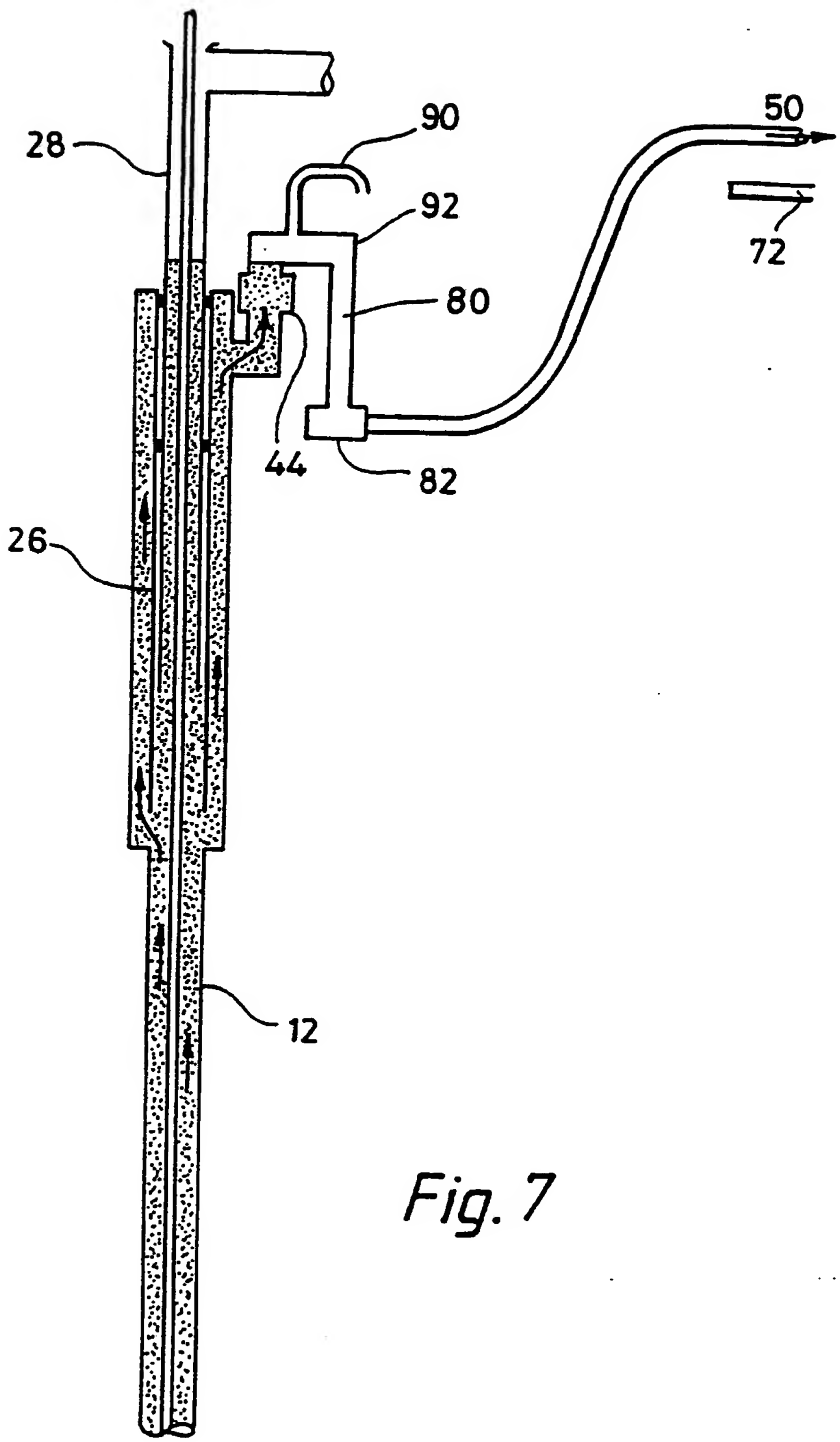

Fig. 7

INTERNATIONAL SEARCH REPORT

International Application N. PCT/GB 92/01673

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 E21B21/08; E21B7/128

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	E21B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category°	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
X	US,A,4 291 772 (P.A.BEYNET) 29 September 1981 see the whole document	21
A	US,A,4 135 841 (B.J.WATKINS) 23 January 1979 see abstract	1,19,20, 21
A	US,A,4 099 582 (L.A.BELL) 11 July 1978 see abstract	1,19,20, 21
A	US,A,3 811 322 (W.J.SWENSON) 21 May 1974 see abstract	1,19,20, 21

° Special categories of cited documents :[10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
08 JANUARY 1993	- 5. 02. 93
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	RAMPELMANN K.

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 9201673 SA 65097

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on 08/01/93
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US-A-4291772	29-09-81	CA-A-	1147646	07-06-83
US-A-4135841	23-01-79	DE-A-	2903777	09-08-79
		FR-A,B	2416415	31-08-79
		GB-A,B	2013760	15-08-79
		JP-A-	54112702	03-09-79
US-A-4099582	11-07-78	None		
US-A-3811322	21-05-74	None		

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82